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Small Grain Cover Crops for Iowa

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SMALL GRAIN COVER CROPS FOR IOWA

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What are Cover Crops?

Cover crops are literally "crops that cover the soil" and are primarily used for erosion control. For most of the Midwest where corn and soybean are grown, cover crops would have to be grown between harvest and planting. Unfortunately, in the upper Midwest (especially north of I-80) the potential growing season for cover crops is usually short and cold, thus limiting their growth and effectiveness. This problem can be partly solved by overseeding cover crops into either corn or soybean in mid-August to early September. Additionally for crops that are harvested relatively early, such as silage corn, seed corn, or early-maturing soybean, a winter-hardy small grain cover crop can be planted with a grain drill or incorporated with shallow tillage before late October.

Why Choose Small Grains as Cover Crops?

Oat, winter wheat, barley, triticale, and winter rye are excellent cover crops because they grow rapidly in cool weather, withstand moderate frost, and their seed is relatively inexpensive or can be produced on site. Many varieties of winter rye, triticale, and winter wheat can overwinter in Iowa and continue growing in the spring. These winter-hardy cover crops must be killed with herbicides or tillage prior to planting corn or soybean. Oat, barley, spring wheat, and some rye, winter wheat, and triticale varieties are not winter hardy in Iowa. They do not survive the winter and do not need to be killed before planting corn and soybean. However, because the non-winter-hardy small grains don't regrow in the spring, they don't produce as much shoot growth as winter rye, triticale, or winter wheat, and therefore don't provide quite as much erosion protection. Legumes are also excellent cover crops and they fix nitrogen as an added benefit. Legumes, however, don't grow as well as the small grains during the fall and winter months, their seed is expensive, and they must be killed with tillage or herbicides in the spring.

What are the Benefits of Using Small Grain Cover Crops?

Reduced Erosion

Small grain cover crops increase surface cover, anchor corn and soybean residues, increase infiltration, and reduce both rill and interrill erosion. Rill erosion is the loss of soil caused by water moving across the soil surface in rills or channels. The small channels, gullies, or rills that farmers often observe in their fields after a heavy rain are caused by rill erosion and these rills are what most people associate with soil erosion. Interrill erosion is soil loss or detachment caused by raindrop impact and sheet flow. This type of erosion is more difficult to see, but it can result in substantial movement of soil down a hillside over many years. In many Iowa fields, spatial variation in crop yield is partly caused by loss of soil from soil from the hilltops and its deposition in the low spots. Yields are reduced on the hilltops because the shallow topsoil holds

less water and nutrients, and in wet years yields are reduced in the low areas because sedimentation has caused these areas to drain more slowly. Cover crops can reduce soil movement, slow the expansion of eroded, low-yielding areas, and help rebuild eroded soils by supplying additional organic matter. A three- year study in Iowa showed that over-seeded rye cover crops in no till reduced interrill erosion by 54% and rill erosion by 90% compared with no till without cover crops. Oat cover crops reduced interrill and rill erosion by 26% and 65%, respectively. The relative reductions in erosion would have been even larger if the comparisons had been made with tilled systems.

Reduced Nitrate Contamination of Water

Nitrogen remaining in the soil after harvest is a significant source of nitrate contamination for groundwater, wells, streams, and lakes in Iowa. Nitrate contributes to algal blooms and excessive growth of aquatic vegetation in surface waters, and has been implicated in the hypoxia problem in the Gulf of Mexico. Annual losses vary, but in Iowa our studies have measured up to 45 lbs/acre of nitrogen lost through leaching. Small grain cover crops can take up nitrate during late fall, winter, and early spring that would otherwise be leached and potentially contaminate water supplies. Nitrate accumulated by the cover crop is then returned to the soil in plant residues and recycled to the following crop. In Iowa, our studies showed that over three years rye cover crops reduced nitrate losses by 96% while oat cover crops reduced losses by 75%.

Increased Soil Organic Matter

Soil organic matter increases soil water-holding capacity and nutrient retention, improves soil structure, minimizes crusting, and releases plant nutrients. Growing small grain cover crops can increase soil organic matter. If the cover crops do not reduce the growth of the primary crops, the cover crop plant matter is an additional source of organic matter for the soil. In our studies, however, we have not been able to measure an increase in soil carbon after 6 years when rye and oat cover crops have been grown following soybean in a corn-soybean rotation. This is not surprising because our current methods for measuring subtle changes in carbon are not sensitive enough and because spatial variation in soil carbon is thirty or forty times greater than the change we are trying to measure.

Currently, we are working on different methods of measuring soil carbon and on different ways to document the effect of management practices, like cover crops, on soil carbon. One approach is to measure soil respiration with and without cover crops. Soil respiration is the loss of carbon from the soil that occurs when organic matter decomposes. Our initial measurements have shown that only some of the carbon added by the cover crops is lost during the following summer and this suggests that there is a net gain of carbon.

Improved Early Season Weed Control

Small grain cover crops can reduce the number of early season weeds and can provide a mulch for continued weed suppression after planting corn or soybean. In our studies, both oat and rye cover crops reduced the number of perennial and winter annual weeds present in no till at corn planting. The rye cover crop following soybean reduced weed numbers by 95% and the oat cover crop by 75%. For corn, we observed that the rye residue continued to suppress weed growth for some time. The effectiveness of the rye mulch was enhanced by the burndown herbicide used to

kill the rye suggesting that for no-till, the burndown herbicide may be the only preplant herbicide needed. Additionally, the mulching effect of the rye residue may also extend weed suppression past planting, and could often reduce the number of post-emergence herbicide applications or mechanical cultivations that are needed. Cover crops that are not winter hardy, like oat, do not produce as much shoot dry matter as winter-hardy cover crops and as a result their weed suppressive effects do not last as long as those of rye. Even so, in no till an oat cover crop may reduce the need for preplant herbicide applications and may allow greater reliance on postemergence herbicides or mechanical cultivation for weed control.

Provide Forage for Ruminants in Spring

Small grain cover crops are an excellent source of high quality forage in the spring for grazing or green chopping.

Can Increase Main Crop Yields in Some Situations

Small grain cover crops can increase primary crop yields on coarse textured or low organic matter soils where soil water often limits crop growth later in the growing season. On these soils in dry years, residues of non-winter hardy cover crops, like oat, can conserve soil moisture through a mulching effect and can recycle plant nutrients through decomposition of the cover crop residues. In Iowa, we have seen slight corn yield increases following oat cover crops in several dry years because the oat cover crop did not deplete soil water in the spring and provided additional surface mulch to reduce evaporation.

What are the Disadvantages of Small Grain Cover Crops?

Increased Costs and Labor

Cover crops cost time and money to plant, manage, and kill. Small grains, however, have less expensive seed than legumes.

Increased Risk of Main Crop Yield Reductions

Small grain cover crops, especially rye, can cause yield reductions in the following crop due to early spring water use, nitrogen immobilization, or rotation affects. Corn yield reductions of up to 28 bu/acre and with an average of 21 bu/acre over seven years have been observed in Iowa following a rye cover crop that was killed at corn planting. Corn yield reductions have not been observed following an oat cover crop, which winterkills. We don't have as much experience with cover crops preceding soybean, but we have not found any evidence that soybean yields would be reduced by small grain cover crops, if the soil profile is fully charged with water at soybean planting. Additionally, we believe that corn yield reductions caused by rye under "normal" or "farmer" management would not be as severe as those observed in our research studies. For one thing, we would not recommend allowing the rye to grow until the time of corn planting, as we did in our studies. The rye should be killed at least two weeks before corn planting to minimize its effect on corn yield. Some preliminary results have indicated that this may prevent a large part of the yield decline. Additionally, by monitoring winter and spring precipitation, tile and stream flow, and extension reports, farmers should be able to determine if their soil profiles have recharged with water since harvest and if not, winter-hardy cover crops, like rye, should be killed as early as possible. We are continuing to work on the management of

winter rye cover crops to reduce the risk of corn yield reductions. Additionally, we have begun searching for winter rye and wheat varieties that don't reduce corn yield. In the meantime, an oat cover crop can be used without fear of reducing corn yield and provides most of the benefits of a winter hardy cover crop.

How are Small Grain Cover Crops Established?

There are several ways to establish small grain cover crops in a corn and soybean rotation. First, small grain cover crops can be overseeded into standing crops in late summer simply by dropping the seed above the main crop canopy and letting it fall to the soil surface. In our field trials, we have drop seeded at 120 lbs/acre for oat and at 80 lbs/acre for rye, but we have not tried different seeding rates. The corn or soybean canopy at this time of year keeps the soil surface shaded and moist following rainfall and this is usually long enough for the small grain seed to germinate and become established. Additionally, falling leaves, especially from soybean, can enhance germination of seed lying on the soil surface. Obviously, this technique is weather dependent and cover crops should not be seeded this way if the upper 6 inches of the soil is dry or if a prolonged dry or hot period is forecast. Aerial seeding into standing corn is usually done with airplanes or helicopters. From our experience, this would be most successful immediately following a good rain in mid-September. Overseeding into standing soybean can be done with aerial seeding in drilled beans or using tractor-mounted drop spreaders or rotary spreaders in row beans. In our field trials, overseeding into soybean is most successful from mid to late August. Ideally, overseeding into soybean should be done when the soybean leaves near the bottom of the plant are just beginning to yellow and the beans are reaching full size. We have also had excellent results in row beans by using a rolling cultivator or similar device to incorporate the cover crop seed. If the seed is incorporated in this way the seeding rate can be reduced.

A second method of establishing small grain cover crops is to wait until the soybean or corn crop has been harvested and use a no-till grain drill or shallow tillage to incorporate the seed. Seeding cover crops into fields planted to seed corn or silage corn, which is harvested earlier than grain corn, can be done after harvest with a grain drill or with a spreader and shallow tillage. Additionally, cover crops can be planted with drills or shallow tillage following harvest of early maturing soybean. Generally, only small grains that overwinter should be planted after the middle of September in central Iowa and no later than mid-October. Even small grains that don't overwinter, like oat and barley, can be overseeded before mid-September.

How Should Small Grain Cover Crops be Managed in the Spring?

Management of winter-hardy small grain cover crops in the Spring is a compromise between maximizing the benefits of the cover crop and minimizing the yield risk to the following crop. The benefits of the cover crop are maximized by allowing the cover crops to grow as long as possible before planting the main crop. The risks of decreasing the yield of the following crop are minimized by using a cover crop that does not overwinter or by killing the cover crop soon after it begins growth in the spring. To minimize the risk of reducing corn yield following rye cover crops the rye cover crop should be killed with glyphosate or by tillage 2 to 3 weeks prior to planting. If the spring is dry or if the soil profile has not been recharged with water since harvest,

then the cover crop should be killed as soon as it begins to regrow in the spring. For soybean following cover crops, the primary concern seems to be depletion of soil water prior to planting. Nonetheless, until we have more evidence or experience we would recommend killing winter-hardy cover crops with a burndown herbicide or tillage two weeks before planting soybean.

How do I start using cover crops?

Talk to someone who is using cover crops.

Read about cover crops in magazines and on the Internet (see below).

Try it on a small area first.

Keep working to improve the system.

Further Reading

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